WHAT IS CLAIMED IS:

1. A node of a telecommunications network which performs a connection admission control (CAC) operation with respect to a new connection by making a determination of log loss ratio and buffer size for a queue having real traffic and imaginary traffic, the connection admission control (CAC) operation admitting the new connection if (1) the determination of log loss is acceptable; (2) the buffer size is acceptable; and (3) the imaginary traffic contribution is non-negative.

2. The apparatus of claim 1, wherein the imaginary traffic is a multiple of a pre-determined set of connections.

3. The apparatus of claim 1, wherein the connection admission control (CAC) operation uses the following four state variables:

(1) a linear term z(s,t) in an approximation to the log loss ratio at a working point (s,t);

(2) an argument c(s,t) of a logarithmic term in the approximation to the log loss ratio at working point (s,t);

(3) a buffer limit B(s,t) used at the working point (s,t); and

(4) a multiplier m(s,t) of the imaginary traffic used at the working point (s,t).

4. The apparatus of claim 3, wherein a value for at least one of the four state variables depends upon an evaluation of a log moment generating function.

5. The apparatus of claim 3, wherein a value for at least one of the four state variables depends upon an evaluation of a log moment generating function and two partial derivatives of the log moment generating function of workload of the queue over a time interval.

6. The apparatus of claim 3, wherein the working point (s,t) is picked from a set of candidate working points as performing well with a particular design traffic mix.

7. The apparatus of claim 1, wherein the determination is made at a predetermined working point.

8. The apparatus of claim 7, wherein the predetermined working point is picked from a set of candidate working points as performing well with a particular design traffic mix.

9. The apparatus of claim 1, wherein, with respect to a new connection, the connection admission control (CAC) operation, at at least one working point, determines whether to admit new traffic by:

(1) making plural determinations, the plural determinations including :

(a) a determination of a log loss approximation q;

(b) a determination of a buffer limit B; and

(c) a determination of a multiplier m of design traffic;

(2) maintaining plural state variables initialized to respective initialization values, the plural state variables being used to make the determinations of (1); and

(3) adding increments to the four state variables for the new connection.

10. The apparatus of claim 9, wherein the plural state variables are:

(1) a linear term $z(s,t)$ in an approximation to the log loss ratio at a working point (s,t);

(2) an argument $c(s,t)$ of a logarithmic term in the approximation to the log loss ratio at working point (s,t);

(3) a buffer limit $B(s,t)$ used at the working point (s,t); and

(4) a multiplier $m(s,t)$ of the imaginary traffic used at the working point (s,t).

11. The apparatus of claim 10, wherein the log loss approximation is $q = z - \log c$.

12. The apparatus of claim 10, wherein the four state variables are maintained at the following respective initialization values:

$$
\begin{aligned}
c(s,t) &= a_c(s;t)\left(Cs + \frac{1}{t}\right) \\
z(s;t) &= a_z(s;t)\left(Cs + \frac{1}{t}\right) - \log(st) \\
B(s;t) &= -Ct + a_B(s;t)\left(Cs + \frac{1}{t}\right) - \frac{1}{s} \\
m(s;t) &= a_m(s;t)\left(Cs + \frac{1}{t}\right)
\end{aligned}
\tag{1}
$$

where

$$
\begin{aligned}
a_c(s;t) &= \frac{R_o}{\frac{\partial}{\partial t}\mu_0(s;t)} \\
a_z(s;t) &= \frac{\mu_0(s;t) - s\frac{\partial}{\partial s}\mu_0(s;t)}{\frac{\partial}{\partial t}\mu_0(s;t)} \\
a_B(s;t) &= \frac{\frac{\partial}{\partial s}\mu_0(s;t)}{\frac{\partial}{\partial t}\mu_0(s;t)} \\
a_m(s;t) &= \frac{1}{\frac{\partial}{\partial t}\mu_0(s;t)}
\end{aligned}
$$

where

R_0	is a mean rate of design traffic;
$\mu_0(s;t)$	is a log moment generating function of design traffic;
$\frac{\partial}{\partial s}\mu_0(s;t)$	is a partial derivative with respect to s, design traffic;

$\frac{\partial}{\partial t}\mu_0(s;t)$ is a partial derivative with respect to t, design traffic;

C is a constant service rate.

13. The apparatus of claim 11, wherein the following increments are added to the four state variables for the new connection:

$$
\begin{aligned}
\Delta c(s;t) &= r - a_c(s;t)\frac{\partial}{\partial t}\mu_a(s;t) \\
\Delta z(s;t) &= \mu_a(s;t) - s\frac{\partial}{\partial s}\mu_a(s;t) - a_z(s;t)\frac{\partial}{\partial t}\mu_a(s;t) \\
\Delta B_R(s;t) &= \frac{\partial}{\partial s}\mu_a(s;t) - a_B(s;t)\frac{\partial}{\partial t}\mu_a(s;t) \\
\Delta m_R(s;t) &= -a_m(s;t)\frac{\partial}{\partial t}\mu_a(s;t)
\end{aligned}
\tag{2}
$$

where

r is a mean rate of the new connection;

$\mu_a(s;t)$ is a log moment generating function of arrival of the new connection;

$\frac{\partial}{\partial s}\mu_a(s;t)$ Partial derivative with respect to s, new connection

$\frac{\partial}{\partial t}\mu_a(s;t)$ is a partial derivative with respect to t, new connection.

14. The apparatus of claim 10, wherein the connection admission control (CAC) operation subtracts the increments of (3) when the new connection is cleared.

15. The apparatus of claim 9, wherein the connection admission control (CAC) operation determines to admit the new connection if all the following are true:

q is less than or equal to the log loss ratio required by the quality of service (QOS) of the traffic;

B is less than or equal to the limit set by available buffer space and QOS delay requirements;

m is non-negative; and

$$R + mR_0 - C \leq (R+mR_0)\,e^{q_{max}}$$

where

R is a mean rate of all real connections, including the new connection;

q_{max} is a log loss ratio required by the QOS of the traffic.

16. The apparatus of claim 10, wherein a set of plural state variables is maintained for each of plural priority levels of connections, each of the plural priority levels having an associated queue.

17. The apparatus of claim 16, wherein the connection admission control operation treats high priority level queue as if lower priority traffic did not exist.

18. The apparatus of claim 16, wherein the connection admission control operation treats a low priority queue as being offered a sum of traffic on the low priority level and all higher priority levels.

19. The apparatus of claim 16, wherein the queues of the plural priority levels share a common buffer space of limited size, and wherein the log loss ratio in a lower priority queue is checked according to the following loss rate inequality:

$$\mathrm{R}e^{q} - R_H e^{q_H} \leq R_L e^{q_{max}} \qquad (3)$$

wherein

R_L is a mean rate of traffic through the lower priority queue;

q_{Lmax} is a log loss ratio required by the traffic through the lower priority queue;

R_H is a mean rate of traffic through all higher priority queues together;

q_H is a log loss ratio of traffic through all higher priority queues together;

R is a mean rate of traffic through the lower priority queue and all higher priority queues together; and

q is a log loss ratio of traffic through the lower priority queue and all higher priority queues together.

20. The apparatus of claim 16, wherein the node has plural servers in series, wherein the plural queues are treated as if served by only one of the servers at a time, each server maintaining a set of the plural state variables, and wherein the connection admission control operation decides to admit the new connection if a slowest server admits the new connection.

21. A connection admission control method for a node of a telecommunications system, the method comprising:

(I) making a determination of log loss ratio and buffer size for a queue having real traffic and imaginary traffic;

(II) admitting a new connection if (1) the determination of log loss ratio is acceptable; (2) the buffer size is acceptable; and (3) the imaginary traffic contribution is non-negative.

22. The method of claim 21, wherein the imaginary traffic is a multiple of a pre-determined set of connections.

23. The method of claim 21, further comprising using the following four state variables in either of step (I) or step (II):

(1) a linear term z(s,t) in an approximation to the log loss ratio at a working point (s,t);

(2) an argument c(s,t) of a logarithmic term in the approximation to the log loss ratio at working point (s,t);

(3) a buffer limit B(s,t) used at the working point (s,t); and

(4) a multiplier m(s,t) of the imaginary traffic used at the working point (s,t).

24. The method of claim 23, wherein a value for at least one of the four state variables depends upon an evaluation of a log moment generating function.

25. The method of claim 23, wherein a value for at least one of the four state variables depends upon an evaluation of a log moment generating function and two partial derivatives of the log moment generating function of workload the queue over a time interval.

26. The method of claim 23, further comprising picking the working point (s,t) from a set of candidate working points as performing well with a particular design traffic mix.

27. The method of claim 23, further comprising making the determination of step (I) is made at a predetermined working point.

28. The method of claim 27, further comprising picking the predetermined working point is picked from a set of candidate working points as performing well with a particular design traffic mix.

29. The method of claim 21, further comprising, determining whether to admit new traffic by:

(1) making plural determinations, the plural determinations including :

(a) a determination of a log loss approximation q;

(b) a determination of a buffer limit B; and

(c) a determination of a multiplier m of design traffic;

(2) maintaining plural state variables initialized to respective initialization values, the plural state variables being used to make the determinations of (1); and

(3) adding increments to the four state variables for the new connection.

30. The method of claim 29, wherein the plural state variables are:

(1) a linear term z(s,t) in an approximation to the log loss ratio at a working point (s,t);

(2) an argument c(s,t) of a logarithmic term in the approximation to the log loss ratio at working point (s,t);

(3) a buffer limit B(s,t) used at the working point (s,t); and

(4) a multiplier m(s,t) of the imaginary traffic used at the working point (s,t).

31. The method of claim 30, wherein the log loss approximation is q = z - log c.

32. The method of claim 30, further comprising maintaining the four state variables at the following respective initialization values:

$$
\begin{aligned}
c(s,t) &= a_c(s;t)\left(Cs + \frac{1}{t}\right) \\
z(s;t) &= a_z(s;t)\left(Cs + \frac{1}{t}\right) - \log(st) \\
B(s;t) &= -Ct + a_B(s;t)\left(Cs + \frac{1}{t}\right) - \frac{1}{s} \\
m(s;t) &= a_m(s;t)\left(Cs + \frac{1}{t}\right)
\end{aligned}
\qquad (1)
$$

where

$$a_c(s;t) = \frac{R_o}{\frac{\partial}{\partial t}\mu_0(s;t)}$$

$$a_z(s;t) = \frac{\mu_0(s;t) - s\frac{\partial}{\partial s}\mu_0(s;t)}{\frac{\partial}{\partial t}\mu_0(s;t)}$$

$$a_B(s;t) = \frac{\frac{\partial}{\partial s}\mu_0(s;t)}{\frac{\partial}{\partial t}\mu_0(s;t)}$$

$$a_m(s;t) = \frac{1}{\frac{\partial}{\partial t}\mu_0(s;t)}$$

where

R_0	is a mean rate of design traffic;
$\mu_0(s;t)$	is a log moment generating function of design traffic;
$\frac{\partial}{\partial s}\mu_0(s;t)$	is a partial derivative with respect to s, design traffic;
$\frac{\partial}{\partial t}\mu_0(s;t)$	is a partial derivative with respect to t, design traffic;
C	is a constant service rate.

33. The method of claim 30, wherein the following increments are added to the four state variables for the new connection:

$$\begin{aligned}
\Delta c(s;t) &= r - a_c(s;t)\frac{\partial}{\partial t}\mu_a(s;t)\\
\Delta z(s;t) &= \mu_a(s;t) - s\frac{\partial}{\partial s}\mu_a(s;t) - a_z(s;t)\frac{\partial}{\partial t}\mu_a(s;t)\\
\Delta B_R(s;t) &= \frac{\partial}{\partial s}\mu_a(s;t) - a_B(s;t)\frac{\partial}{\partial t}\mu_a(s;t)\\
\Delta m_R(s;t) &= -a_m(s;t)\frac{\partial}{\partial t}\mu_a(s;t)
\end{aligned} \tag{2}$$

where

r	is a mean rate of the new connection;
$\mu_a(s;t)$	is a log moment generating function of arrival of the new connection;
$\frac{\partial}{\partial s}\mu_a(s;t)$	Partial derivative with respect to s, new connection
$\frac{\partial}{\partial t}\mu_a(s;t)$	is a partial derivative with respect to t, new connection.

34. The method of claim 29, wherein the connection admission control (CAC) operation subtracts the increments of (3) when the new connection is cleared.

35. The method of claim 29, wherein the connection admission control (CAC) operation determines to admit the new connection if all the following are true:

q is less than or equal to the log loss ratio required by the quality of service (QOS) of the traffic;

B is less than or equal to the limit set by available buffer space and QOS delay requirements;

m is non-negative; and

$R + mR_0 - C \leq (R+mR_0)\, e^{q_{max}}$

where

R is a mean rate of all real connections, including the new connection;

q_{max} is a log loss ratio required by the QOS of the traffic.

36. The method of claim 29, further comprising maintaining a set of plural state variables for each of plural priority levels of connections, each of the plural priority levels having an associated queue.

37. The method of claim 36, further comprising treating a high priority level queue as if lower priority traffic did not exist.

38. The method of claim 36, further comprising treating a low priority queue as being offered a sum of traffic on the low priority level and all higher priority levels.

39. The method of claim 36, further comprising the queues of the plural priority levels sharing a common buffer space of limited size, and further comprising checking the log loss ratio in a lower priority queue according to the following loss rate inequality:

$$Re^{q} - R_H e^{q_H} \le R_L e^{q_{max}} \qquad (3)$$

wherein

R_L is a mean rate of traffic through the lower priority queue;

q_{Lmax} is a log loss ratio required by the traffic through the lower priority queue;

R_H is a mean rate of traffic through all higher priority queues together;

q_H is a log loss ratio of traffic through all higher priority queues together;

R is a mean rate of traffic through the lower priority queue and all higher priority queues together; and

q is a log loss ratio of traffic through the lower priority queue and all higher priority queues together.

40. The method of claim 36, further comprising providing plural servers in series in the node, treating the plural queues as if served by only one of the servers at a time, maintaining a set of the plural state variables at each server, and deciding to admit the new connection if the slowest server admits the new connection.